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(71)Applicant : AOKI KAZUO
GOMI YASUAKI
TORAI RAITO INVESTMENT LTD

(72)Inventor : MIYAZAWA KUNIAKI

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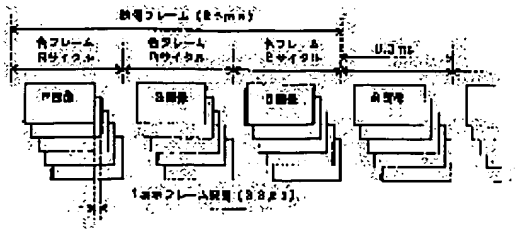
(54) COLOR PANNEL DISPLAY DEVICE AND METHOD OF PROCESSING IMAGE INFORMATION

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a three-color back light type color pannel display device capable of displaying images gradationwise with high contrast.

SOLUTION: Image information is converted into serial data so that the color data of each color: red(R), green(G) and blue(B) are sequentially changed in an image frame, and the image data for one image is over-written several times in a display frame cycle in the frame of each color, and then liquid crystal is intermettently driven by several times. Accordingly, in comparison with the case where liquid crystal is driven continuously, the operation speed of liquid crystal is made high speed and a large operation quantity is assured, thereby providing a high contrast image in each short color frame. Furthermore, by controlling the number of times of over-writing a gradationwise display is made possible.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the display which consists of two or more pixels from which color panel-display equipment is started, especially it drives according to image information, and a light transmittance changes, and the color panel-display equipment equipped with the back light light source of R [in which on-off control is independently possible respectively], G, and B each color according to the image information.
[0002]
[Description of the Prior Art] In recent years, lightweight-izing and thin shape-ization is demanded also about the display unit with lightweight [of home electronics such as OA equipment, such as a personal computer, and television,], and thin-shape-izing. Therefore, development of lightweight [, such as a liquid crystal display (LCD),] and a thin flat panel type display is furthered as what is replaced with CRT which has spread conventionally.
[0003] Full color-ization is mentioned as one of the technical items required of these flat panel type displays. For example, the color LCD of a TFT method has realized colorization by adopting an active matrix method. According to this TFT method, even if it carries out a pulse drive per dot, it is possible by giving a memory effect by the capacitor to offer LCD which the high duty drive of was attained and was excellent in contrast. However, since much TFT of VGA specification is needed, the trouble of the badness of the yield on cost quantity and manufacture was held, and it has resulted by the end of today.
[0004] On the other hand, by the STN method, by adopting a simple matrix method, colorization was realized and it has succeeded in offering the color LCD of a low cost. However, when frame speed is slow and it is easy to produce color mixture, it has the trouble that contrast is bad. Then, in order to realize high contrast and a high-speed frame display, a double matrix electrode drive method and various drive methods, such as a time-sharing drive method, are proposed. Moreover, a small pulse is distributed instead of a big selection pulse, simultaneous scanning of all the lines is carried out, and the active addressing drive method which tried realization of high contrast and a high frame display, without lowering resolution is proposed.
[0005] by the way, make many of conventional colors LCD into a TFT method -- a STN method -- an imitation -- the light-filter method using the light filter which consists of the three primary colors of R (red), G (green), and B (blue) is adopted And in turning on R, for example, it is performing color display by considering the field of R as transparency and considering the field of G and B as nontransparent. However, even if it thinks simply, in the case of a light-filter method, you have to drive a 3 times [in case R G, and the pixel that corresponds for every area B respectively are eye a required hatchet and monochrome display] as many pixel as this. therefore -- if drive technology is also complicated when very detailed processing is required, in order to acquire the picture of high resolution, and the permeability of the light filter itself is raised and it is **** -- ** -- color-balance adjustment is still more difficult -- etc. -- many troubles which should be solved are held
[0006] Then, recently, the light source with which R and G which are indicated by JP,4-338996,A, for example, and B each color became independent, respectively is turned on periodically one by one, and the color panel display using the light source of R [which can acquire a full color picture], G, and B each color of 3 color back light method is proposed by adding the chrominance signal corresponding to each pixel synchronizing with the lighting period, respectively.
[0007]
[Problem(s) to be Solved by the Invention] by the way, since it is possible to process R, G, and B signal with a parallel

data, to display the picture of the high brightness in R signal by the conventional light-filter method, for example Regardless of the behavior of G signal and B signal, by using the memory effect of the capacitor in the drive circuit of LCD, it was possible to have carried out overwrite of the image data to R field of a pixel, and it was possible to have obtained the color image of high contrast easily.

[0008] However, by 3 color back light method, once the image information of R, G, and B each color changes color picture information into the serial data which changes one by one by the predetermined time period, the serial data of each color changes, it is made to synchronize with a period, and colorization is realized by making the back light of R, G, and B each color turn on one by one. Therefore, even if it was the case where he wanted to display the picture of the high brightness in R signal as shown in drawing 11 for example, and it turned ON liquid crystal of a predetermined pixel field with R signal, since it will be turned OFF by G signal and B signal with the following period, the high amount of transmitted lights was not obtained and the color picture of high contrast was not able to be obtained. And since this performance of operation appeared notably especially when a STN method realizes colorization, desire of the solution was carried out.

[0009] When this invention is accomplished in view of the above troubles faced when 3 color back light method tends to realize colorization of a panel display, therefore the purpose of this invention improves the driving signal of a pixel, it is possible to raise the frame responsibility ability of each pixel and to obtain the color image of high contrast, and it is the optimal thing especially for LCD of a STN method for which new and the improved color panel-display equipment are offered.

[0010] Moreover, another purpose of this invention is a thing which image information is developed at high speed and can attain improvement in the speed of the information transfer rate to LCD and for which new and the improved color panel-display equipment are offered.

[0011]

[Means for Solving the Problem] in order to solve the above-mentioned technical problem, this invention was equipped with the back light light source of R [in which on-off control is independently possible respectively], G, and B each color according to the display which consists of two or more pixels from which it drives according to image information, and a light transmittance changes, and its image information -- the display unit of new and improved 3 color back light method is offered And a means to change color picture information into the above-mentioned display unit at the serial data from which the image information of R, G, and B each color changes one by one by the predetermined time period according to the 1st viewpoint of this invention, A means to change the serial data of R [in each time period], G, and B each color into the drawing data of R and G which drive two or more pixels of predetermined within the limits, respectively, and B each color, Based on the drawing data of R, G, and B each color, a means to drive two or more pixels which are in predetermined within the limits repeatedly two or more times is established in each time period. In this case, it is desirable to establish further a means to control the number of times which drives two or more pixels in predetermined within the limits, in each time period according to the gradation information acquired from image information.

[0012] Moreover, a means to change color picture information into the above-mentioned display unit at the serial data from which the image information of R, G, and B each color changes one by one by the predetermined time period according to another viewpoint of this invention, R in each time period, G, and a 1st data bus means to develop the serial data of B each color parallel to L pieces, By writing simultaneously L parallel datas corresponding to each pixel in the L addresses one by one about each pixel of the MxN individual of predetermined within the limits A memory means to store L drawing data which consist of the pixel information on an MxN individual, A selection means to choose K drawing data from L drawing data, and the 2nd data bus means which reads K selected drawing data from a memory means in M pixel information [every] N steps, respectively, The driving means which drive the pixel of the MxN individual of predetermined within the limits K times in a time period with K read drawing data are prepared. And it is possible to determine the number of times K which chooses drawing data in that case according to the gradation information for which a selection means is acquired from the aforementioned image information.

[0013] According to viewpoint that this invention is still more nearly another, the above-mentioned display unit A means to change color picture information into the serial data from which the image information of R, G, and B each color changes one by one by the predetermined time period, R in each time period, G, and a 1st data bus means to develop parallel to the number of whole floor tones (L) of which the serial data of B each color is required, By writing simultaneously L parallel datas corresponding to each pixel in the L addresses one by one about each pixel of the MxN individual of predetermined within the limits A memory means to store L drawing data which consist of the pixel

information on an MxN individual, The 2nd data bus means which reads the drawing data of the number of gradation (K) required of the drawing data to read from a memory means in M pixel information [every] N steps, respectively, It has the driving means which drive the pixel of the MxN individual of predetermined within the limits K times in a time period with K read drawing data.

[0014] It faces processing image information through the memory which has at least three addresses from which area differs according to viewpoint that this invention is another further again, only the address of the data area developed parallel is made into all address effectives, and the art of image information characterized by processing parallel the data specified by the residual address is offered. In this case, it is with the time of write-in operation and read-out operation, and it is possible to constitute so that the data areas made into all address effectives may differ.

[0015] According to this invention, it separates into the color data of R, G, and B each color, and the usual composite signal of an NTSC color TV system is changed into the serial data from which these color data change with a predetermined period, for example. In addition, R signal will be represented here and operation of this invention will be explained. First, when carrying out the vertical 2 division drive of the predetermined range, for example, the picture of 640x480 dots, from R signal included in each period of serial data, R color drawing data for 640x240 dots are formed. And by carrying out within each period repeatedly [multiple-times], and driving the pixel of above-mentioned within the limits based on this drawing data, it becomes possible to move liquid crystal greatly, and high brightness can be obtained. in addition, the thing for which the number of times which drives a pixel is adjusted according to gradation information -- for example, by increasing the number of times of a drive, when high brightness is required, and reducing the number of times of a drive, when low brightness is enough, it becomes possible to make a picture produce a gradation difference, and the picture of high contrast can be acquired

[0016] Operation of this invention is explained more concretely. R signal changed into serial data as mentioned above is parallel developed by the 1st data bus means according to the number of whole floor tones (for example, L= 256) demanded. And by storing the data of 256 in the memory which has the respectively separate gradation address, 256 R color drawing data for 640x240 dots are formed. Subsequently, once it forms R color drawing data in memory in this way, R color drawing data of a draft are far read at high speed rather than the conventional sequential read-out operation with the need of reading every 1-dot 640x240 times data at once, by reading every 640-dot 240 times data at once according to each line address. And since according to this invention the R color each drawing data read at high speed in this way are read multiple times (a maximum of 256 times) over T / 256 hours in each color frame and drive a pixel The total drive time (T) can obtain the amount of liquid crystal operation of a latus dynamic range far as compared with the conventional method which drives a pixel only once only over T hours as it is equal. Therefore, as compared with the conventional method, it is possible to acquire the picture of high contrast. In addition, it is also possible to express a gradation difference by choosing the number of times which drives a pixel according to the number of gradation (it driving [in the case of for example a whole floor tone] 128 times in the case of a 256 times drive and 1/2 gradation).

[0017] Moreover, according to the art of the image information constituted based on this invention, the memory group which the display information about each pixel managed, for example with the line address and a data-selector dress is gradation-ized by the gradation address as an indicative data according to gradation, and can store it is prepared. As this shows typically drawing 10 , after making the gradation address into all address effectives, and decoding 8-bit data, for example, developing to 256 data buses, at the time of write-in operation, 256 bits is parallel written in by specification of a line dress (0-239) and a data-selector dress (0-639) corresponding to each gradation address. On the other hand, at the time of read-out operation, a data-selector dress can be made into all address effectives, and the indicative data for each line can be parallel read by specification of the gradation address (0-255) and the line address (0-239).

[0018] as mentioned above, the address of a data area [according to this method] to develop parallel combining three kinds of addresses from which area differs according to operation -- all the addresses -- by confirming, it can become possible to process a lot of data simultaneously, the information transfer rate to LCD can be accelerated to 1 time of clock timing, and the response of a LCD drive can be raised to it

[0019]

[Embodiments of the Invention] The form of suitable operation of this invention is explained referring to an accompanying drawing below.

[0020] 1. **** of a frame -- first explain the fundamental concept of operation (repeat means of displaying is called hereafter.) of the color display equipment constituted based on this invention, referring to drawing 1 In repeat means of displaying, it is ****** for which the frame frequency from which three kinds of properties, (1) image frame, (2) color

frame, and (3) display frames, differ is prepared, and explains from the concept of these frames.
[0021] (1) The image frame of image frame ** is the biggest frame unit, for example, is the frequency (time period) about 40-50Hz (20-25mS). The composite signal of an NTSC color TV system is changed into the serial data which changes one by one by the time period of the color frame which mentions the image information of R, G, and B each color later after separating into the color data of R, G, and B each color. And an image frame is defined as sum total time of the color frame time period of R [of this serial data], G, and B each color draft. Since R picture, G picture, and B picture are compounded visually and recognized as a color picture in this image frame, the time period of the color frame described below and a display frame can be determined by setting this image frame as the grade which can obtain quality sufficient as a color picture.
[0022] (2) A color frame color frame is a time period from which the information about each color changes within the serial data constituted as mentioned above. Moreover, if it says by the relation with an image frame, a color frame will be the time period which assigned the image frame to three in order to display the image information of R, G, and B each color, for example, a color frame will be the frequency (time period) about 120Hz - 150Hz (6.6mS-8.3mS) to set an image frame as 40-50Hz (20-25mS) grade. Therefore, if this color frame excels, since the number of times of a repeat display by the display frame described below will increase, it is possible to extend the dynamic range of the variation of liquid crystal and to obtain the image of high contrast. However, if a color frame is too long, since it is visually recognized as a flicker, it is not desirable. Therefore, it is necessary to set up a color frame as an adjustment value of various parameters, such as a flicker and contrast, in fact. In addition, by the conventional 3 color back light method, since improvement in quality of image was aimed at by adjustment of this color frame, when there was a limitation in the contrast acquired naturally, especially it applied to a STN method, a satisfying color picture was not able to be obtained. In the repeat means of displaying by this point and this invention, the picture of higher contrast can be acquired by taking in the concept of the display frame described below.
[0023] (3) According to a display frame, now this invention, the image information of each color obtained from the serial data of R, G, and B each color is changed into the drawing data which drive the pixel for 640x240 dots when carrying out the vertical 2 division drive of the predetermined range (the drawing range is called hereafter.), for example, the picture of 640x480 dots. And this display frame is defined as time to drive the pixel of the above-mentioned drawing range once using this drawing data in the above-mentioned color frame. Therefore, it is so possible that the time period of this display frame is long to expand the drawing range. however -- since the repeat means of displaying by this invention is what is going to expand the variation of the liquid crystal integrated by performing multiple-times drawing in this display frame unit, and is going to acquire the picture of high contrast by color frame within the limits of each color so that it may mention later -- the time period of a display frame -- ** -- if short, when the number of times of drawing also increases so much, it is possible to acquire higher contrast Moreover, since it has the intention of giving a gradation difference by adjusting the number of times of drawing by the display frame, the number of gradation can be made to increase in this repeat means of displaying by shortening the time period of a display frame and increasing the number of times of drawing so that it may mention later. Therefore, it is necessary to take into consideration various parameters, such as a drawing range, contrast, and the number of gradation, in determining the time period of a display frame. For example, when it is necessary to insert 256 times of display frames into 1 time of a color frame for example, when all 256 gradation expresses, and a color frame is set up with 120Hz - 150Hz (6.6mS-8.3mS), a display frame is the frequency (time period) about 30kHz - 38kHz (26microS-33microS).
[0024] 2. basic operation of repeat means of displaying -- it was constituted based on this invention, referring to drawing 2 next -- explain operation of the display unit of means of displaying repeatedly Paying attention to the performance of liquid crystal of operation to a driving signal showing an integration property at the time of a standup, and showing a differential property at the time of falling, if the summary of this invention has the the same total drive time It is in making high the integrated value of the amount of operation of the liquid crystal performed at each drive time by dividing the total drive time and driving repeat liquid crystal over multiple times rather than the amount of operation of the liquid crystal produced as a result of driving liquid crystal continuously over the total drive time.
[0025] By the conventional 3 color back light method, after only Tx time's having set the actuating signal to ON and driving liquid crystal in the meantime (t0-t2), the display "on" period of t0-t3 had been obtained by making an actuating signal off and carrying out natural damping of the liquid crystal. Therefore, the amount Y1 of operation of the liquid crystal in the conventional actuating signal can be expressed with the following number (1).
[0026]

[Equation 1]

$$Y1 = \oint_{t2}^{t0} \qquad (1)$$

[0027] On the other hand, in repeat means of displaying, although each drive time (Ta, Tb, --) is short, since the good portion (Y2) of the response of operation at the time of the standup of liquid crystal is repeated and used, a conventional method and the conventional total number of times can acquire the bigger value as the same amount Y4 of operation of the liquid crystal integrated but (TX=Ta+Tb+, --, +Tn) than the conventional amount Y1 of liquid crystal operation. That is, the amount Y2 of standups of the liquid crystal within each drive time in repeat means of displaying is expressed with the following number (2).

[0028]

[Equation 2]

$$Y2 = \oint_{t1}^{t0} \qquad (2)$$

[0029] Moreover, the amount Y3 of fallings of the liquid crystal within each drive time in repeat means of displaying is expressed with the following number (3).

[0030]

[Equation 3]

$$Y3 = \sum_{t1}^{t2} \qquad (3)$$

[0031] Therefore, the amount Y4 of addition of operation of the liquid crystal obtained within the total time (TX=Ta+Tb+, --, +Tn) is expressed with the following number (4). Since it is set to Y4>Y1, if it is the same ON time according to the repeat means of displaying by this invention, it is more possible than the above result to obtain the amount of operation of far bigger liquid crystal than the conventional method. That is, if it bases and explains to drawing 1 , it will become possible to obtain the amount of operation of far high liquid crystal within each color frame as compared with the conventional method by setting up the time period of a display frame as Tx which is the sum total of each drive time (Ta, Tb, --+Tn), and performing a repeat display over multiple times within the time period of each color frame.

[0032]

[Equation 4]

$$Y4 = \oint_{t4}^{t0} (y2 - y3) \qquad (4)$$

[0033] 3. According to the gradation expression this invention by repeat means of displaying, it is possible by adjusting the number of times of drawing by the display frame within each color frame to express display gradation.

[0034] That is, according to the repeat means of displaying of this invention, as shown in drawing 3 , it becomes possible by adjusting the on-off timing of a liquid crystal driving signal to adjust the amount of addition operation of liquid crystal. For example, it is possible by drawing in all display frames to display the whole floor tone which makes operation of liquid crystal reach even the saturation point. Moreover, by drawing in the display frame of the number of times of the half, it becomes possible to draw 1/2 gradation with possible making operation of liquid crystal reach even the efficiency 1 of operation. By furthermore drawing in the display frame of the number of times of the half, 1/4 gradation with possible making operation of liquid crystal reach even the efficiency 2 of operation can be drawn. Thus, according to this invention, it is possible by adjusting the number of times of drawing by the display frame within each color frame to express display gradation.

[0035] in addition, when controlling display gradation, it is also possible to display by carrying out multiple-times reading appearance of the same drawing information according to gradation data However, a more nearly high-speed frame response can be obtained by only the number of whole floor tones preparing beforehand the drawing information managed by the gradation address so that it may mention later, and displaying by beginning to read each drawing information one by one according to gradation information. Moreover, it is also possible to display gradation as

combination of the set by considering the display frame of the predetermined number of times as a set so that it may mention later. For example, when managing drawing information by the memory which has the gradation address of 256, it is also possible to also constitute so that 256 steps of gradation data may be set up and the drawing information on the arbitrary number of times may be read out of it, and to constitute eight steps of gradation data, using the display frame of 32 batches as one set, and to perform color display of eight gradation, although it is possible.

[0036] 4. One example of the system configuration of the color display equipment by the repeat means of displaying based on a system configuration this invention is shown in drawing 4 - drawing 8 . However, if it is this contractor, it is possible to design various system configurations within the limits of the technical thought indicated by the claim, and belonging to the technical range of this invention naturally also about those system configurations cannot be overemphasized.

[0037] With the composition of this example, it is changed into 8-bit binary data by A/D converter 12, after changing into the RGB serial data from which the classification-by-color rate of the usual composite signal of the NTSC color TV system inputted every 16.6mS is carried out by the RGB selector 10, and R, G, and B each color changes periodically for every color frame. Subsequently, the indicative data for one screen of each color contained in each color frame is divided into the up screen-display data and lower screen-display data which express a vertical screen by the L/U selector 14, respectively, and is sent to data-selector 16U and data-selector 16D, respectively. For example, when performing the display of 640x480 dots, 640x240-bit screen-display data are sent to data selectors 16U and 16D as vertical each drawing field, respectively. In addition, the vertical synchronization and horizontal synchronization of a STNC signal are counted by the timing decoder 18, and they are used in order to take the synchronization of various signals.

[0038] Now, according to the position on a screen, it is parallel developed by several required gradation minutes, 256 [for example,], through the 1st data bus 20U and 20D by data selectors 16U and 16D, and the image data sent to data selectors 16U and 16D is developed by the data composition RAM groups 24U and 24D according to the line address signal and gradation address signal which are sent from address counters 22U and 22D. The image data for 640x240 bits managed about the image information for one image frame as a result by the gradation address per [256] color frame of R, G, and B each color will be stored. In addition, about the write-in timing to the data composition RAM groups 24U and 24D, it is possible to carry out to timing of operation as shown in drawing 7 .

[0039] This point is explained in full detail, referring to drawing 5 and drawing 6 . In addition, the memory composition for 1 pixel is shown in drawing 5 , and the array of data and the content of data which were developed by the data composition RAM groups 24U and 24D, respectively are shown in drawing 6 at it. As shown in drawing 5 , according to the number of gradation, it is parallel developed by 256 about R, G, and B each color by the 1st data bus 20 from a data selector 24, and the image data for 1 pixel is stored in the storing position of 256 managed by gradation address counter 22a, respectively. In addition, the positional information on 1 screen of these pixel data is managed by line address counter 22b. Thus, as shown in drawing 6 , lessons will be taken from each pixel field specified by the data selection area of 640, and the line address of 240, and image information will be developed and stored in the data composition RAM groups 24U and 24D by the gradation address of 256, respectively. And drawing 1 showed this situation typically and signs that each image data piles up as a display frame by gradation per each color frame, and is stored are shown.

[0040] The image data stored in the data composition RAM groups 24U and 24D as mentioned above can drive each pixel of vertical each liquid crystal display sections 30U and 30D which count by line counters 28U and 28D, are read at once by the 2nd data bus meanses 26U and 26D by every one line 240 lines, and have the viewing area of 640x480 dots by them. And in that case, according to the repeat means of displaying by this invention, according to the gradation information on each screen, as shown in drawing 3 , a required number of image information is read one by one by specifying the gradation address in which the image data to read is stored. Thus, while expanding the amount of operation of liquid crystal by constituting a system as compared with the conventional method, it is possible to attain gradation-ization of liquid crystal operation and to realize high-speed information transfer to a display further. In addition, about the read-out timing from the data composition RAM groups 24U and 24D, it is possible to carry out to timing of operation as shown in drawing 8 . Moreover, about the timing of a more concrete display action, it mentions later, referring to drawing 9 .

[0041] 5. Explain, referring to the timing chart shown in drawing 9 about an example of the display action of the display-action timing of repeat means of displaying, next the system which can carry out the repeat means of displaying by this invention constituted as mentioned above. In addition, in the example shown in drawing 9 , in order to give explanation simple, color display shall be performed to a 32 dot (4 bit x8 clock) x32 dot drawing field.

[0042] For example, since 4-bit data display for 1 dot can be performed by one pulse (100nS) when controlling by making the pulse signal of 100nS into a dot clock signal, 800nS is required in order [of 32 dots] to carry out data display for one line. Thus, it is possible to display the image information for one screen by displaying by every one line 32 lines, and, according to this invention in the time period which this operation takes, it is as having already explained to be set up as a display frame. And in the case of this example, 25.6microS is required as a display frame. Furthermore, according to this invention, it is possible by repeating this display frame 256 times, constituting the color frame of 6.55mS, and repeating and displaying drawing to acquire high contrast. Moreover, in order to express gradation, in this example, eight steps of gradation data were set up for the display frame of 256 batches for every 819.2 more Smicro and 32-set display frame, and the composition which makes the number of times of drawing manage by the gradation address is adopted. In addition, although 32 times of continuous display frames are made into one set and gradation data are constituted from this example, it cannot be overemphasized that it is also possible to make every 1+8n position, 2+8n position, and the n-th [--8+8] display frame (however, n= 0, 1, -- 31) into one set, and to constitute gradation data, respectively. Thus, the color frame of R, G, and B each color is constituted by the display frame of 256 batches, the image frame for 19.66mS(s) is constituted by displaying the color frame of R, G, and B each color by a unit of 1 time, and the color image which is high contrast and has desired gradation as a result is displayed by the high response.

[0043] In addition, although the liquid crystal display (LCD) was mentioned as the example and the above example explained this invention, this invention is not limited to this example. this invention can be applied to all the panel displays of 3 color back light method, for example, when panel displays, such as a magnetic fluid display (Japanese Patent Application No. No. 191787 [five to], Japanese Patent Application No. No. 270063 [five to], Japanese Patent Application No. No. 156816 [six to]) concerning an applicant for this patent, perform color display, it can be applied suitably. Moreover, although this invention method is adopted especially suitable for LCD of a STN method, this invention is applicable also to LCD of various methods, such as not only a STN method but a TFT method, an ECB method, a ferroelectricity method, a field sequential system, etc.

[0044]

[Effect of the Invention] Since this invention is constituted as mentioned above, it can do so an outstanding effect which is explained below.

[0045] (1) Since according to the high speed this invention of the working speed of the liquid crystal by repeat means of displaying multiple-times overwrite of the image data for one screen is carried out within each color frame, and liquid crystal is intermittently divided into multiple times and is driven, as compared with the case where liquid crystal is driven continuously, the working speed of liquid crystal can be accelerated, the big amount of operation can be secured, and the image of high contrast can be obtained within each color frame short as a result.

[0046] (2) According to the gradation-ized this invention of liquid crystal operation by the number-of-times control of a display of repeat means of displaying, it is possible to express a gradation difference within each short color frame by adjusting the number of times which carries out overwrite of the image data for one screen within each color frame. That is, a gradation difference can be expressed by increasing the number of times of a repeat display, and reducing the number of times of a repeat display, when lower brightness is enough to obtain high brightness.

[0047] (3) According to one example of the system configuration of the high speed this invention of the information transfer to LCD, the memory group which the display information about each pixel managed with the line address and a data-selector dress is gradation-ized by the gradation address as an indicative data according to gradation, and can store it is prepared. Therefore, at the time of write-in operation, as typically shown in drawing 10 , after making the gradation address into all address effectives, and decoding 8-bit data, for example, developing to 256 data buses, corresponding to each gradation address, 256 bits is parallel written in by specification of a line dress (0-239) and a data-selector dress (0-639). On the other hand, at the time of read-out operation, a data-selector dress is made into all address effectives, and the indicative data for each line is parallel read by specification of the gradation address (0-255) and the line address (0-239).

[0048] as mentioned above, the address of a data area to develop parallel in this invention combining three kinds of addresses from which area differs according to operation -- all the addresses -- by confirming, it can become possible to process a lot of data simultaneously, the information transfer rate to LCD can be accelerated to 1 time of clock timing, and the response of a LCD drive can be raised to it

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[Translation done.]